

# Assignment 3

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a) Combinations twice and triple

Number of classes: 5

Number of attributes: 4

('Blood\_Type', 'Give\_Birth')

('Blood\_Type', 'Can\_Fly')

('Blood\_Type', 'Live\_Water')

('Blood\_Type', 'Give\_Birth', 'Can\_Fly')

('Blood\_Type', 'Give\_Birth', 'Live\_Water')

('Blood\_Type', 'Can\_Fly', 'Live\_Water')

('Give\_Birth', 'Can\_Fly')

('Give\_Birth', 'Live\_Water')

('Give\_Birth', 'Can\_Fly', 'Live\_Water')

('Can\_Fly', 'Live\_Water')

b) Single attribute rules

Blood\_Type=warm->mammals

Blood\_Type=warm->birds

Blood\_Type=cold->reptiles

Blood\_Type=cold->fishes

Blood\_Type=cold->amphibians

Give\_Birth=yes->mammals

Give\_Birth=yes->fishes

Give\_Birth=no->mammals

Give\_Birth=no->reptiles

Give\_Birth=no->fishes

Give\_Birth=no->amphibians

Give\_Birth=no->birds

Can\_Fly=no->mammals  
Can\_Fly=no->reptiles  
Can\_Fly=no->fishes  
Can\_Fly=no->amphibians  
Can\_Fly=no->birds  
Can\_Fly=yes->mammals  
Can\_Fly=yes->birds  
Live\_Water=no->mammals  
Live\_Water=no->reptiles  
Live\_Water=no->birds  
Live\_Water=yes->mammals  
Live\_Water=yes->fishes  
Live\_Water=sometimes->reptiles  
Live\_Water=sometimes->amphibians  
Live\_Water=sometimes->birds

c) Double attributes rules

Blood\_Type=warm^Give\_Birth=yes->mammals  
Blood\_Type=warm^Give\_Birth=no->mammals  
Blood\_Type=warm^Give\_Birth=no->birds  
Blood\_Type=cold^Give\_Birth=yes->fishes  
Blood\_Type=cold^Give\_Birth=no->reptiles  
Blood\_Type=cold^Give\_Birth=no->fishes  
Blood\_Type=cold^Give\_Birth=no->amphibians  
Blood\_Type=warm^Can\_Fly=no->mammals  
Blood\_Type=warm^Can\_Fly=no->birds  
Blood\_Type=warm^Can\_Fly=yes->mammals  
Blood\_Type=warm^Can\_Fly=yes->birds  
Blood\_Type=cold^Can\_Fly=no->reptiles  
Blood\_Type=cold^Can\_Fly=no->fishes  
Blood\_Type=cold^Can\_Fly=no->amphibians

Blood\_Type=warm^Live\_Water=no->mammals  
Blood\_Type=warm^Live\_Water=no->birds  
Blood\_Type=warm^Live\_Water=yes->mammals  
Blood\_Type=warm^Live\_Water=sometimes->birds  
Blood\_Type=cold^Live\_Water=no->reptiles  
Blood\_Type=cold^Live\_Water=yes->fishes  
Blood\_Type=cold^Live\_Water=sometimes->reptiles  
Blood\_Type=cold^Live\_Water=sometimes->amphibians  
Give\_Birth=yes^Can\_Fly=no->mammals  
Give\_Birth=yes^Can\_Fly=no->fishes  
Give\_Birth=yes^Can\_Fly=yes->mammals  
Give\_Birth=no^Can\_Fly=no->mammals  
Give\_Birth=no^Can\_Fly=no->reptiles  
Give\_Birth=no^Can\_Fly=no->fishes  
Give\_Birth=no^Can\_Fly=no->amphibians  
Give\_Birth=no^Can\_Fly=no->birds  
Give\_Birth=no^Can\_Fly=yes->birds  
Give\_Birth=yes^Live\_Water=no->mammals  
Give\_Birth=yes^Live\_Water=yes->mammals  
Give\_Birth=yes^Live\_Water=yes->fishes  
Give\_Birth=no^Live\_Water=no->mammals  
Give\_Birth=no^Live\_Water=no->reptiles  
Give\_Birth=no^Live\_Water=no->birds  
Give\_Birth=no^Live\_Water=yes->fishes  
Give\_Birth=no^Live\_Water=sometimes->reptiles  
Give\_Birth=no^Live\_Water=sometimes->amphibians  
Give\_Birth=no^Live\_Water=sometimes->birds  
Can\_Fly=no^Live\_Water=no->mammals  
Can\_Fly=no^Live\_Water=no->reptiles  
Can\_Fly=no^Live\_Water=yes->mammals  
Can\_Fly=no^Live\_Water=yes->fishes

Can\_Fly=no^Live\_Water=sometimes->reptiles

Can\_Fly=no^Live\_Water=sometimes->amphibians

Can\_Fly=no^Live\_Water=sometimes->birds

Can\_Fly=yes^Live\_Water=no->mammals

Can\_Fly=yes^Live\_Water=no->birds

#### d) Triple attributes rules

Blood\_Type=warm^Give\_Birth=yes^Can\_Fly=no->mammals

Blood\_Type=warm^Give\_Birth=yes^Can\_Fly=yes->mammals

Blood\_Type=warm^Give\_Birth=no^Can\_Fly=no->mammals

Blood\_Type=warm^Give\_Birth=no^Can\_Fly=no->birds

Blood\_Type=warm^Give\_Birth=no^Can\_Fly=yes->birds

Blood\_Type=cold^Give\_Birth=yes^Can\_Fly=no->fishes

Blood\_Type=cold^Give\_Birth=no^Can\_Fly=no->reptiles

Blood\_Type=cold^Give\_Birth=no^Can\_Fly=no->fishes

Blood\_Type=cold^Give\_Birth=no^Can\_Fly=no->amphibians

Blood\_Type=warm^Give\_Birth=yes^Live\_Water=no->mammals

Blood\_Type=warm^Give\_Birth=yes^Live\_Water=yes->mammals

Blood\_Type=warm^Give\_Birth=no^Live\_Water=no->mammals

Blood\_Type=warm^Give\_Birth=no^Live\_Water=no->birds

Blood\_Type=warm^Give\_Birth=no^Live\_Water=sometimes->birds

Blood\_Type=cold^Give\_Birth=yes^Live\_Water=yes->fishes

Blood\_Type=cold^Give\_Birth=no^Live\_Water=no->reptiles

Blood\_Type=cold^Give\_Birth=no^Live\_Water=yes->fishes

Blood\_Type=cold^Give\_Birth=no^Live\_Water=sometimes->reptiles

Blood\_Type=cold^Give\_Birth=no^Live\_Water=sometimes->amphibians

Blood\_Type=warm^Can\_Fly=no^Live\_Water=no->mammals

Blood\_Type=warm^Can\_Fly=no^Live\_Water=yes->mammals

Blood\_Type=warm^Can\_Fly=no^Live\_Water=sometimes->birds

Blood\_Type=warm^Can\_Fly=yes^Live\_Water=no->mammals

Blood\_Type=warm^Can\_Fly=yes^Live\_Water=no->birds

Blood\_Type=cold^Can\_Fly=no^Live\_Water=no->reptiles  
 Blood\_Type=cold^Can\_Fly=no^Live\_Water=yes->fishes  
 Blood\_Type=cold^Can\_Fly=no^Live\_Water=sometimes->reptiles  
 Blood\_Type=cold^Can\_Fly=no^Live\_Water=sometimes->amphibians  
 Give\_Birth=yes^Can\_Fly=no^Live\_Water=no->mammals  
 Give\_Birth=yes^Can\_Fly=no^Live\_Water=yes->mammals  
 Give\_Birth=yes^Can\_Fly=no^Live\_Water=yes->fishes  
 Give\_Birth=yes^Can\_Fly=yes^Live\_Water=no->mammals  
 Give\_Birth=no^Can\_Fly=no^Live\_Water=no->mammals  
 Give\_Birth=no^Can\_Fly=no^Live\_Water=no->reptiles  
 Give\_Birth=no^Can\_Fly=no^Live\_Water=yes->fishes  
 Give\_Birth=no^Can\_Fly=no^Live\_Water=sometimes->reptiles  
 Give\_Birth=no^Can\_Fly=no^Live\_Water=sometimes->amphibians  
 Give\_Birth=no^Can\_Fly=no^Live\_Water=sometimes->birds  
 Give\_Birth=no^Can\_Fly=yes^Live\_Water=no->birds

e) Total Rule Count: 116

----- All Rules -----

Blood\_Type=warm->mammals  
 Blood\_Type=warm->birds  
 Blood\_Type=cold->reptiles  
 Blood\_Type=cold->fishes  
 Blood\_Type=cold->amphibians  
 Give\_Birth=yes->mammals  
 Give\_Birth=yes->fishes  
 Give\_Birth=no->mammals  
 Give\_Birth=no->reptiles  
 Give\_Birth=no->fishes  
 Give\_Birth=no->amphibians  
 Give\_Birth=no->birds  
 Can\_Fly=no->mammals

Can\_Fly=no->reptiles  
Can\_Fly=no->fishes  
Can\_Fly=no->amphibians  
Can\_Fly=no->birds  
Can\_Fly=yes->mammals  
Can\_Fly=yes->birds  
Live\_Water=no->mammals  
Live\_Water=no->reptiles  
Live\_Water=no->birds  
Live\_Water=yes->mammals  
Live\_Water=yes->fishes  
Live\_Water=sometimes->reptiles  
Live\_Water=sometimes->amphibians  
Live\_Water=sometimes->birds  
Blood\_Type=warm^Give\_Birth=yes->mammals  
Blood\_Type=warm^Give\_Birth=no->mammals  
Blood\_Type=warm^Give\_Birth=no->birds  
Blood\_Type=cold^Give\_Birth=yes->fishes  
Blood\_Type=cold^Give\_Birth=no->reptiles  
Blood\_Type=cold^Give\_Birth=no->fishes  
Blood\_Type=cold^Give\_Birth=no->amphibians  
Blood\_Type=warm^Can\_Fly=no->mammals  
Blood\_Type=warm^Can\_Fly=no->birds  
Blood\_Type=warm^Can\_Fly=yes->mammals  
Blood\_Type=warm^Can\_Fly=yes->birds  
Blood\_Type=cold^Can\_Fly=no->reptiles  
Blood\_Type=cold^Can\_Fly=no->fishes  
Blood\_Type=cold^Can\_Fly=no->amphibians  
Blood\_Type=warm^Live\_Water=no->mammals  
Blood\_Type=warm^Live\_Water=no->birds  
Blood\_Type=warm^Live\_Water=yes->mammals

Blood\_Type=warm^Live\_Water=sometimes->birds  
Blood\_Type=cold^Live\_Water=no->reptiles  
Blood\_Type=cold^Live\_Water=yes->fishes  
Blood\_Type=cold^Live\_Water=sometimes->reptiles  
Blood\_Type=cold^Live\_Water=sometimes->amphibians  
Blood\_Type=warm^Give\_Birth=yes^Can\_Fly=no->mammals  
Blood\_Type=warm^Give\_Birth=yes^Can\_Fly=yes->mammals  
Blood\_Type=warm^Give\_Birth=no^Can\_Fly=no->mammals  
Blood\_Type=warm^Give\_Birth=no^Can\_Fly=no->birds  
Blood\_Type=warm^Give\_Birth=no^Can\_Fly=yes->birds  
Blood\_Type=cold^Give\_Birth=yes^Can\_Fly=no->fishes  
Blood\_Type=cold^Give\_Birth=no^Can\_Fly=no->reptiles  
Blood\_Type=cold^Give\_Birth=no^Can\_Fly=no->fishes  
Blood\_Type=cold^Give\_Birth=no^Can\_Fly=no->amphibians  
Blood\_Type=warm^Give\_Birth=yes^Live\_Water=no->mammals  
Blood\_Type=warm^Give\_Birth=yes^Live\_Water=yes->mammals  
Blood\_Type=warm^Give\_Birth=no^Live\_Water=no->mammals  
Blood\_Type=warm^Give\_Birth=no^Live\_Water=no->birds  
Blood\_Type=warm^Give\_Birth=no^Live\_Water=sometimes->birds  
Blood\_Type=cold^Give\_Birth=yes^Live\_Water=yes->fishes  
Blood\_Type=cold^Give\_Birth=no^Live\_Water=no->reptiles  
Blood\_Type=cold^Give\_Birth=no^Live\_Water=yes->fishes  
Blood\_Type=cold^Give\_Birth=no^Live\_Water=sometimes->reptiles  
Blood\_Type=cold^Give\_Birth=no^Live\_Water=sometimes->amphibians  
Blood\_Type=warm^Can\_Fly=no^Live\_Water=no->mammals  
Blood\_Type=warm^Can\_Fly=no^Live\_Water=yes->mammals  
Blood\_Type=warm^Can\_Fly=no^Live\_Water=sometimes->birds  
Blood\_Type=warm^Can\_Fly=yes^Live\_Water=no->mammals  
Blood\_Type=warm^Can\_Fly=yes^Live\_Water=no->birds  
Blood\_Type=cold^Can\_Fly=no^Live\_Water=no->reptiles  
Blood\_Type=cold^Can\_Fly=no^Live\_Water=yes->fishes

Blood\_Type=cold^Can\_Fly=no^Live\_Water=sometimes->reptiles  
Blood\_Type=cold^Can\_Fly=no^Live\_Water=sometimes->amphibians  
Give\_Birth=yes^Can\_Fly=no->mammals  
Give\_Birth=yes^Can\_Fly=no->fishes  
Give\_Birth=yes^Can\_Fly=yes->mammals  
Give\_Birth=no^Can\_Fly=no->mammals  
Give\_Birth=no^Can\_Fly=no->reptiles  
Give\_Birth=no^Can\_Fly=no->fishes  
Give\_Birth=no^Can\_Fly=no->amphibians  
Give\_Birth=no^Can\_Fly=no->birds  
Give\_Birth=no^Can\_Fly=yes->birds  
Give\_Birth=yes^Live\_Water=no->mammals  
Give\_Birth=yes^Live\_Water=yes->mammals  
Give\_Birth=yes^Live\_Water=yes->fishes  
Give\_Birth=no^Live\_Water=no->mammals  
Give\_Birth=no^Live\_Water=no->reptiles  
Give\_Birth=no^Live\_Water=no->birds  
Give\_Birth=no^Live\_Water=yes->fishes  
Give\_Birth=no^Live\_Water=sometimes->reptiles  
Give\_Birth=no^Live\_Water=sometimes->amphibians  
Give\_Birth=no^Live\_Water=sometimes->birds  
Give\_Birth=yes^Can\_Fly=no^Live\_Water=no->mammals  
Give\_Birth=yes^Can\_Fly=no^Live\_Water=yes->mammals  
Give\_Birth=yes^Can\_Fly=no^Live\_Water=yes->fishes  
Give\_Birth=yes^Can\_Fly=yes^Live\_Water=no->mammals  
Give\_Birth=no^Can\_Fly=no^Live\_Water=no->mammals  
Give\_Birth=no^Can\_Fly=no^Live\_Water=no->reptiles  
Give\_Birth=no^Can\_Fly=no^Live\_Water=yes->fishes  
Give\_Birth=no^Can\_Fly=no^Live\_Water=sometimes->reptiles  
Give\_Birth=no^Can\_Fly=no^Live\_Water=sometimes->amphibians  
Give\_Birth=no^Can\_Fly=no^Live\_Water=sometimes->birds



Give\_Birth=no^Can\_Fly=yes^Live\_Water=no->birds

Can\_Fly=no^Live\_Water=no->mammals

Can\_Fly=no^Live\_Water=no->reptiles

Can\_Fly=no^Live\_Water=yes->mammals

Can\_Fly=no^Live\_Water=yes->fishes

Can\_Fly=no^Live\_Water=sometimes->reptiles

Can\_Fly=no^Live\_Water=sometimes->amphibians

Can\_Fly=no^Live\_Water=sometimes->birds

Can\_Fly=yes^Live\_Water=no->mammals

Can\_Fly=yes^Live\_Water=no->birds

f)

#### Top 10 rules by Coverage:

1. Can\_Fly=no->mammals
2. Can\_Fly=no->reptiles
3. Can\_Fly=no->fishes
4. Can\_Fly=no->amphibians
5. Can\_Fly=no->birds
6. Give\_Birth=no->mammals
7. Give\_Birth=no->reptiles
8. Give\_Birth=no->fishes
9. Give\_Birth=no->amphibians
10. Give\_Birth=no->birds

#### Top 10 rules by Accuracy:

1. Blood\_Type=warm^Give\_Birth=yes->mammals
2. Blood\_Type=cold^Give\_Birth=yes->fishes
3. Blood\_Type=warm^Live\_Water=yes->mammals
4. Blood\_Type=warm^Live\_Water=sometimes->birds
5. Blood\_Type=cold^Live\_Water=no->reptiles
6. Blood\_Type=cold^Live\_Water=yes->fishes
7. Blood\_Type=warm^Give\_Birth=yes^Can\_Fly=no->mammals
8. Blood\_Type=warm^Give\_Birth=yes^Can\_Fly=yes->mammals
9. Blood\_Type=warm^Give\_Birth=no^Can\_Fly=yes->birds
10. Blood\_Type=cold^Give\_Birth=yes^Can\_Fly=no->fishes

g)

#### Class predictions by Coverage

ID	Blood_Type	Give_Birth	Can_Fly	Live_Water	Class
Record1	warm	no	yes	no	mammals
Record2	warm	yes	no	yes	mammals
Record3	cold	yes	no	no	mammals
Record4	cold	no	no	yes	mammals

For record 1 -> 6 7 8 9 10 triggered and 6 selected by order

For record 2 -> 1 2 3 4 5 triggered and 1 selected by order

For record 3 -> 1 2 3 4 5 triggered and 1 selected by order

For record 4 -> All triggered and 1 selected by order

#### Class predictions by Accuracy

ID	Blood_Type	Give_Birth	Can_Fly	Live_Water	Class
Record1	warm	no	yes	no	birds
Record2	warm	yes	no	yes	mammals
Record3	cold	yes	no	no	fishes
Record4	cold	no	no	yes	fishes

For record 1 -> Only 9 triggered

For record 2 -> 1, 3, 7 triggered and 1 selected by order

For record 3 -> 2, 5, 10 triggered and 2 selected by order

For record 4 -> Only 6 triggered